



DEPARTMENT OF DEFENSE

**DEFENSE ENVIRONMENTAL
TECHNOLOGY PROGRAM**

AUGUST 2000

**A REPORT TO CONGRESS
FISCAL YEAR 1999**

Preface

The Department of Defense (DoD) has a legal obligation to comply with environmental regulations and Executive Orders to ensure that its industrial and operational activities meet national, regional, state, and local standards. The DoD chooses to be proactive in these matters and strives to expedite resolution of pending environmental issues. One of the most effective strategies for reducing the expense of meeting DoD's environmental obligations is to implement an aggressive program to:

- identify, adapt, and/or develop new technologies to meet current and projected environmental standards,
- minimize the need for future operation and maintenance investments, and
- enable the DoD to efficiently and effectively respond to DoD's environmental requirements, with minimum impact to training and operational requirements.

To successfully accomplish this strategy, the DoD invests a portion of its annual research and development (R&D) budget toward development of fundamental environmental knowledge, tools, processes, techniques, and methodologies that enhance DoD's environmental posture. Environmental Quality science and technology (S&T) programs form the essential foundation for this strategy.

Regardless of the level of the Environmental Technology budget, the DoD does not intend, nor can it expect, to resolve its environmental problems independently. These substantial and difficult issues require a coordinated effort among the brightest and most innovative minds in the nation. Since many of the environmental issues facing the DoD are similar to those of many manufacturers and institutions, DoD's strategy is, and will continue to be, one of primary dependence on the private sector for technical solutions. Similar issues among the other Federal agencies and departments dictate a close linking with their R&D infrastructures to capture advances made on these issues. Accordingly, one might view Defense investments in Environmental Technology as a smaller, yet significant, part of the larger picture. These investments are specifically reserved to address those pressing and intractable environmental problems that are either unique to military training and operations, or are a sufficiently costly environmental issue such that private sector or other Federal sector investment in technology development is insufficient to meet DoD requirements. Examples of this situation are detection and remediation of unexploded ordnance (UXO), land management tools for military base commanders, remediation of chlorinated solvents, and developing environmentally benign propellants, explosives, and pyrotechnics. Nevertheless, in each of these situations, the DoD depends on industry for commercialization and implementation of these novel technological developments as they develop and mature through the R&D process.

This report will focus on the Environmental Quality S&T investments and the environmental Demonstration/Validation investments within the DoD and will provide a snapshot of the Department's Fiscal Year 1999 Environmental R&D efforts. It will also describe the investment control processes used by DoD and the military Services for selection, prioritization, management, and evaluation of environmental technologies.

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I. INTRODUCTION

A. Purpose

Section 323 of the National Defense Authorization Act for Fiscal Year 2000, Public Law 106-65, amended Section 2706 of Chapter 160 of Title 10, United States Code, to establish the requirement for an annual report on the DoD Environmental Technology Program and an initial report on the investment control process.

Section 323 further amended Chapter 160 of Title 10, United States Code, to add Section 2709, which requires the Secretary of Defense to ensure the technology planning process provides for an investment control process for the selection, prioritization, management, and evaluation of environmental technologies by the DoD, the military departments, and the Defense Agencies.

The purpose of this report is to fulfill the statutory requirements cited above. This is the first of the required annual reports. As such, this report addresses the Environmental Technology investment control process as required by statute.

B. Scope

This report addresses those projects that are identified in the President's Budget as Environmental Technology in Budget Activities one (1) through four (4) as well as Congressional Interest items within the Environmental Technology area. The report details the Environmental Technology programs of the three Military Departments as well as those budgeted and executed by the Office of the Secretary of Defense (OSD). The investment control processes used by the Military Departments, the Defense agencies and Defense-wide, from requirements establishment through execution, are detailed in this report. These processes result in a coherent, consolidated environmental technology program that is coordinated across all of the organizations involved.

The Environmental Technology Program encompasses four thrust areas or pillars: Cleanup, Conservation, Pollution Prevention, and Compliance. These pillars are in consonance with the organizational structure for Environmental Technology established by the Committee on Environment and Natural Resources (CENR) of the National Science and Technology Council (NSTC) under the Office of Science and Technology Policy.

C. Service and Agency Programs

Each of the military departments has an Environmental Technology research and development program that is designed to meet the needs of the Service. In areas where there are common needs across the Services, coordination is accomplished through several mechanisms. Within Science and Technology (S&T), Services use the Reliance Process, which is a formal agreement among the Services that identifies Service responsibilities regarding development for all technologies, including Environmental Quality. For Demonstration and Validation (Dem/Val) projects, multi-Service coordination bodies, such as elements of the Joint Logistics

Commanders, serve to coordinate needs, specifications and metrics, performers, and responses to performance metrics.

In addition, there are two Defense-wide programs designed to address the common needs of the Services: the Strategic Environmental Research and Development Program (SERDP) for science and technology and the Environmental Security Technology Certification Program (ESTCP) for demonstration and validation. The Defense Advanced Research Projects Agency (DARPA) represents a third defense Research, Development, Test & Evaluation (RDT&E) environmentally related program; however, it represents less than one percent of the Defense Environmental Technology appropriation in FY 1999. Each sponsor's program is defined below.

ARMY

The Army environmental technology R&D program includes science and technology from Basic Research (6.1) through Advanced Development (6.3). No Army Demonstration/Validation (6.4) program existed in FY 1999. The Army's investments in its Environmental Quality Technology Program support the Army's Objective Force and invests in all four pillars of environmental technology, i.e., Restoration (cleanup), Conservation, Pollution Prevention, and Compliance. The Deputy Assistant Secretary of the Army for Environment, Safety, and Occupational Health is the advocate for the program and provides the user requirements. The program is executed predominantly through the Army Research Laboratory and the Army Corps of Engineers laboratory system. The Army also serves as the executive agent for the National Defense Center for Environmental Excellence (NDCEE). The NDCEE is a national leadership organization that addresses high-priority environmental problems for the DoD, other government organizations, and industry.

NAVY

The Navy environmental technology R&D program spans from Basic Research through Demonstration/Validation. The focus of the program is primarily on Pollution Prevention and Compliance with a strong emphasis in support of new shipboard and aviation systems. Aviation systems' R&D is coordinated with the Air Force and industry. The advocate for the program is the Deputy Assistant Secretary of the Navy for Environment and Safety. Requirements management of the program is directed by the Office of the Chief of Naval Operations, Environmental Protection, Safety and Occupational Health Division (N45). Execution management is shared by the Office of Naval Research (S&T) and the SYSCOMS (Dem/Val), including Naval Sea Systems Command, Naval Facilities Engineering Command, and Naval Air Warfare Systems Command.

AIR FORCE

The Air Force environmental technology R&D program is focused predominantly on Compliance and Pollution Prevention with programs in Basic Research through Demonstration and Validation. The Deputy Assistant Secretary of the Air Force for Environment, Safety, and Occupational Health is the advocate for the program. The Air Force Office of Scientific Research executes the Basic Research program while the Air Force Research Laboratory

executes the Applied and Advanced Research program. HQ AFCEE and HQ AFMC execute the Air Force Demonstration and Validation program. Because its technical challenges are common with the aerospace industry, significant leveraging with private sector and other Services' programs is a prominent feature of Air Force programs.

STRATEGIC ENVIRONMENTAL RESEARCH AND DEVELOPMENT PROGRAM (SERDP)

The SERDP program, established by the Fiscal Year 1991 Defense Authorization Act, is a tri-agency program consisting of participants from DoD, the Department of Energy (DOE), and the Environmental Protection Agency (EPA). This multi-agency management feature ensures effective transfer of ideas, information, and technology within and outside of the Federal R&D infrastructure. The program invests in Basic Research through Advanced Development across all four pillars of environmental technology and is focused on cross-service issues. SERDP is managed by a tri-Service program office and reports to the Deputy Director, Defense Research and Engineering.

ENVIRONMENTAL SECURITY TECHNOLOGY CERTIFICATION PROGRAM (ESTCP)

ESTCP is a Demonstration/Validation program that was established in Fiscal Year 1995. Its purpose is to demonstrate and validate promising, innovative technologies that target the DoD's most urgent environmental needs in Compliance, Cleanup, and Pollution Prevention. ESTCP's strategy is to select lab-proven technologies that offer broad DoD and market application. ESTCP demonstrates enabling promising technologies to receive regulatory and end user acceptance in order to be fielded and commercialized more rapidly. ESTCP is jointly managed with SERDP through a tri-Service program office and reports to the Deputy Under Secretary of Defense for Environmental Security. Strong emphasis on satisfying multi-Service needs and industry participation promotes efficient use of RDT&E funds and effective technology transfer.

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY (DARPA)

DARPA is the central R&D organization for the DoD. It manages and directs selected basic and applied R&D projects for the DoD, and pursues research and technology where both risk and payoff are very high and where success may provide dramatic advances for traditional military roles and missions and dual-use applications. DARPA reports to the Director, Defense Research and Engineering (DDR&E).

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II. INVESTMENT CONTROL PROCESS

A. Overview

The DoD employs an extensive and thorough process by which R&D programs are developed, selected, managed, and evaluated. Generally, requirements are founded in the Department's effort to achieve and remain in compliance with Federal, state, and local regulations, as well as to meet its commitment to be a good steward of the environment. Figure II-1 illustrates the technology development process for environmental technology, including stages of development, oversight organization, and sponsorship for each stage. Implicit in each stage is a requirement that a technology pass fundamental milestones prior to advancing to the next stage of development.

Environmental Technology Development Process

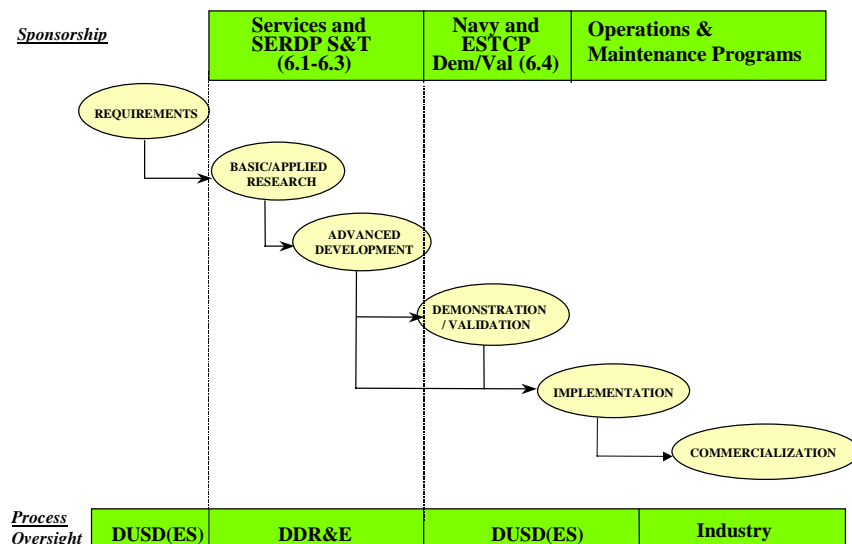


Figure II-1

The process begins by articulating the needs for improved technology to meet requirements of the Services and the DoD user community. These requirements may be expressed in terms of needing quicker and less expensive means to remediate existing contamination, to needing a process for stripping and repainting tactical vehicles that produces less hazardous waste, to needing improved management techniques for threatened and endangered species. Some of these requirements can be satisfied by the commercial sector in the form of products and services. Other needs may not have an immediate solution and hence must be translated into requirements for R&D by a joint group composed of the end user and R&D communities.

Once the requirements for R&D have been defined, the process of aligning resources to address the requirement begins. The first step is found in the Defense Planning Guidance (DPG), which sets broad goals and objectives for the Defense budget and provides the Services with specific guidance for developing their budget requests. The Services develop their requests through the Planning, Programming, and Budgeting Process. This process is well-documented and will not be discussed here.

With the requirements and funding identified, the Services, SERDP, and ESTCP formulate programs to address the highest priority needs while staying within their respective existing budgets. These programs are, by the very nature of R&D, multi-year in design, and range from basic research, to full-scale field demonstration and validation. S&T investments are coordinated across Defense through the Reliance Process, which is executed by the Joint Engineers Management Panel (JEMP) for Environmental Technology. Dem/Val investments are coordinated by one of several operational-area-specific, multi-Service, coordinating bodies, such as the Joint Ordnance Commander's Group (JOCG), the Joint Aeronautical Commander's Group (JACG), and Joint Group on Pollution Prevention (JG-PP), to ensure that the needs of multiple Services are met.

At this point in the process, a coordinated, coherent, well-defined program has been developed to address the highest priority environmental needs within the existing President's Budget Request. Funding that may be appropriated above the President's Budget Request has not and cannot be considered within this planning process. Efficient execution of such additions is difficult because they are single-year appropriations and are frequently accompanied by legislation or report language that directs the funding to be used for purposes that do not address high priority requirements.

Each working project has associated overall goals and objectives to be achieved over the life of the project. In addition, there are a series of annual objectives or milestones that are the metrics by which the project's progress is judged. These goals, objectives, and milestones are written with varying degrees of specificity, depending upon the project's stage in the R&D process. Basic research goals and objectives are defined very broadly while demonstration/validation goals and objectives are very specific in terms of cost, schedule, and performance. Each working project is reviewed at least annually and normally more frequently. The timing, structure, and format of performance reviews vary among executing organizations, but all have the basic elements of technical progress and obligation and expenditure performance. The Environmental Technology Program as a whole is also reviewed to ensure technical progress, balance, and relevance in light of the requirements. Each effort must undergo this annual review prior to being considered for follow-on funding under the next higher development program.

The sections of this report that follow detail the various aspects of the Investment Control processes used by the Services and the Department. As noted previously, these processes are not mirror images among the executing organizations. However, each organization's processes contain the vital elements that are essential to ensuring that the planned program addresses the highest priority requirements of the respective Service as efficiently as possible within the allocated funding.

B. Coordination of Technology Development

Multiple mechanisms exist to coordinate technology development within DoD. S&T activities within the Department are coordinated through the Reliance Process. Working for over 10 years now, the Reliance Process provides a structure for assigning leads and cooperative partners in developing defense technologies. For Environmental Quality S&T, the Reliance Process is vested in the JEMP. The JEMP consists of senior members from the Services and OSD installation and engineer communities who have responsibility for their organizations' environmental quality issues. Through the JEMP, the specific technical area responsibilities for developing environmental technologies are delegated to a specific Service. The other Services rely upon that responsible Service to provide the primary science and technology effort within that technology area. In those areas where no one Service has the lead, the JEMP provides the forum for collaboration and exchange, which reduces the chance for duplication of effort and enhances joint acceptance of new technologies.

The level of collaboration among the Federal agencies has grown significantly in the past five years through programs such as SERDP and ESTCP. Both of these programs have technical review committees with members from all of the Services as well as the DOE and the EPA. Figure II-2 illustrates the JEMP coordination matrix under Reliance for Environmental Quality. Service responsibility for each pillar and technology area is represented by (A) for Army, (N) for Navy, and (AF) for Air Force. Listing more than one Service indicates a cooperative responsibility for the area.

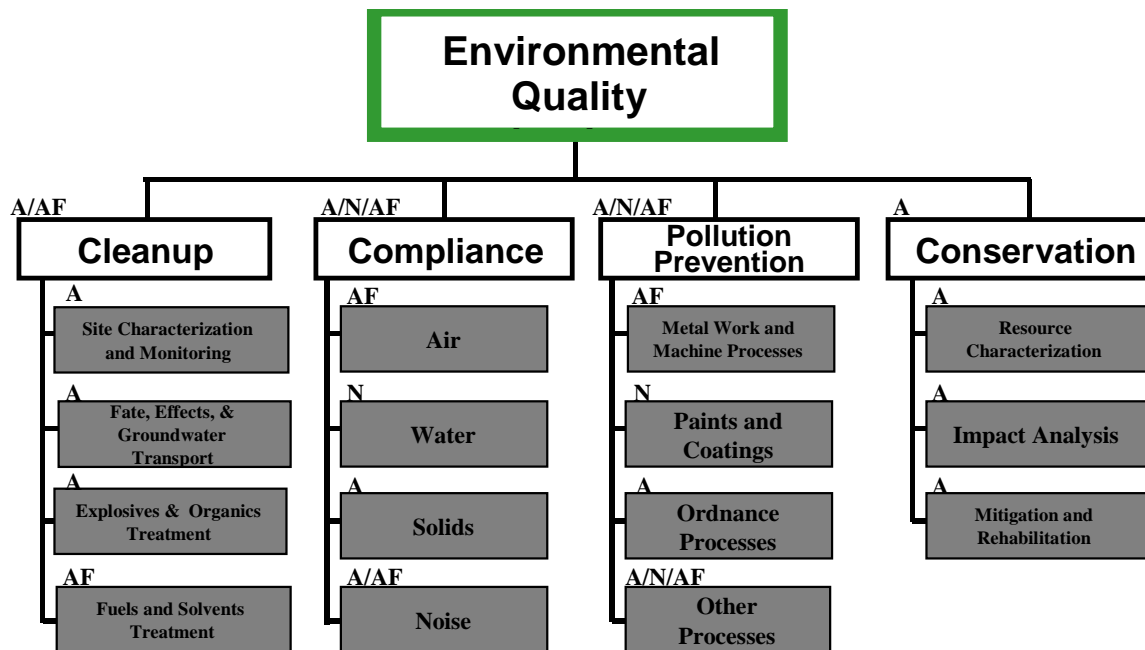


Figure II-2

As technology matures to the demonstration/validation stage, the Services' Engineering Service Centers (ESC) are the predominant coordinators of the projects. These Centers, including the Army Environmental Center (AEC), the Naval Facilities Engineering Service Center (NFESC),

and the Air Force Center for Environmental Excellence (AFCEE), strive to demonstrate the utility of the technology within a specific Service platform, system, or process under the coordination of the Tri-Service Environmental Support Centers Coordinating Committee (TSESCCC). In the performance of the demonstration, several coordination bodies exist to reap the benefits of a particular technology demonstration for multiple Service use. Under the Joint Logistics Commanders, operational-area-specific coordinating groups perform this function. For example, new weapons development technologies are coordinated with the support of the JG-PP; aviation materials substitutions are coordinated with the support of the JACG; and ordnance issues are coordinated through the JOCG. In addition, technology-area-specific activities, such as the Hard Chrome Alternatives Team (HCAT), focus on alternative technology in that specific technical area in support of the Joint Services.

The TSESCCC consists of members from the AEC, AFCEE, the NFESC, and the Defense Logistics Agency (DLA). The TSESCCC meets three times a year to coordinate tri-service activities relative to environmental programs, technologies, and issues of concern. The committee exchanges technical and regulatory information to leverage available resources and to avoid duplication of effort. The TSESCCC enhances technology transfer among the services and has achieved significant cost avoidance through the various joint programs such as the Joint Service Pollution Prevention Technical Library, the Joint Service Procedural Guidelines for Ecological Risk Assessments, and the Tri-Service Remedial Project Manager's Handbook for Ecological Risk Assessment. The TSESCCC also hosts the Tri-Service Environmental Technology Workshop and the Joint Service Pollution Prevention Conference and Exhibition to exchange technologies, ideas, and success stories.

C. Environmental Technology Requirements

It is critical that the limited funds available for environmental technology R&D be focused on the highest priority requirements of the Services. Each Service develops prioritized user requirements through internal processes that include members of the technology user community. These requirements are collected, cross-leveled, and prioritized at the DoD level by the DUSD(ES) through the Environmental Security Technology Requirements Group (ESTRG). The ESTRG is composed of the officials responsible for the Environmental Security programs within the Services and representatives of the R&D community. Specifically the membership consists of the following:

Voting Members:

- Deputy Under Secretary of Defense for Environmental Security [DUSD(ES)]
- Department of Army – Deputy Assistant Secretary of Army for ESOH, Installations & Environment [DASA(ESOH, I&E)]
- Department of Navy – Deputy Assistant Secretary of Navy for Environment and Safety [DASN(E&S)] and Chief of Naval Operations (OPNAV N45G)
- Department of Air Force – Assistant Secretary of Air Force for ESOH (SAF/MIQ) and Installations and Logistics, Environmental Division (HQ USAF/ILEV)
- Defense Logistics Agency (DLA) – Director of DLA for Environment & Safety

Non-Voting Advisors are represented by the following offices and working groups:

- Director, Defense Research & Engineering (DDR&E)
- Strategic Environmental Research & Development Program (SERDP)
- Joint Engineers Management Panel (JEMP)
- Environmental Security Technology Certification Program (ESTCP)
- Army Environmental Programs (DAIM-ED)
- Human Systems Center Directorate of Planning (HSC/XRE)

Requirements submitted to the ESTRG are validated and ranked into high, medium, and low categories based on the priorities assigned by the Services. They are published as the Defense Environmental Security Technology Requirements Strategy (DETRS).

The DETRS forms the basis of the Defense Technology Objectives (DTO) for environmental technology programs of the Services, SERDP, and the ESTCP. The environmental technology DTOs are merged with other DTOs for other defense technology requirements within the DoD to form the overarching Defense Technology Area Plan (DTAP). The DTOs and the DTAP are developed jointly by the Services and DDR&E through the Reliance Process and form the basis for all DoD Science and Technology initiatives.

The sections below briefly describe the military Services' approach to requirements development and provide a short discussion of how SERDP and ESTCP use established requirements. While each approach may be different, they achieve their objectives with consistency.

ARMY

Documentation of the Army's environmental quality technology (EQT) requirements have been an iterative process that began with a series of meetings in 1993 and the Office of the Directorate of Environmental Programs (ODEP) publication, U.S. Army Environmental Requirements and Needs, January 1994. Quantification of the Army's environmental quality technology requirements was initiated in 1995. As a result of the development of the Army environmental quality technology management oversight process and the recognition that environmental quality technology requirements were vital to that process in 1997, a need was recognized for a formal process to generate and update Army environmental quality technology requirements. The Army Environmental Center (AEC) subsequently developed the Army Environmental Requirements and Technology Assessments (AERTA) process to satisfy that need.

Development and documentation of the Army's environmental quality technology requirements is a two part process. One part is that each of the services is required to submit its technology requirements to the Environmental Security Technology Requirements Group (ESTRG) to help DoD maximize EQT research, development, test, and evaluation (RDT&E) funding by reducing duplication of effort. The other part is the Army's high-priority environmental quality technology requirements are utilized to formulate environmental quality technology programs that are proposed to the Army's major commands (MACOM) for potential funding.

The Army's environmental quality technology program described herein represents the critical RDT&E requirements for accomplishing the Army's mission with the least impact or threat to the environment. These needs are Army-level needs and include installation- or weapon-specific needs only when that need is critical to the execution of the Army's mission. The requirements are reviewed for their responsiveness to the Chief of Staff of the Army's vision, impacts to readiness and quality of life, impact or threat to the environment, and timeliness needed for the Army to maintain compliance with environmental regulations.

The cost and extent of the environmental issues are documented to illustrate the level of funding being expended each year to: address each issue; identify how many MACOMs, installations, or weapon systems are being impacted; and facilitate return-on-investment calculations in the development of EQT management plans. A management plan is prepared for each funded, high-priority Army EQT program. All MACOMs; major subordinate-commands (MSCs); the Office of the Deputy Chief of Staff of Operations and Plans; the Office of the Deputy Chief of Staff for Logistics; the Office of the Assistant Secretary of the Army for Acquisition, Logistics, and Technology; and the Office of the Assistant Chief of Staff for Installations and Environment are involved in establishing the prioritized and validated list of the Army's EQT requirements. The Army's EQT requirements are used by the Assistant Secretary of the Army for Acquisition, Logistics, and Technology, potential MACOMs, and the EQT Technology Teams to formulate programs against the high-priority requirements and to prepare management plans for each program.

NAVY

The Navy's Environmental Protection RDT&E Program develops and implements a wide range of cost-effective technologies to ensure that its sea, air, and land operations and their supporting infrastructure comply with environmental laws, regulations, Executive Orders, and DoD/Navy policies. The office of the Chief of Naval Operations (CNO) collects and reviews extensive information on the Navy's mission needs, environmental performance, legal requirements, and emerging environmental problems. Each year, this information is used to update the Navy's environmental RDT&E requirements. These requirements encompass both common and unique environmental issues pertaining to ships, submarines, shore facilities, and aviation interests.

An integrated process is used annually to define ongoing and new environmental problems and translate them into validated and prioritized requirements. This process is directed by the CNO and involves representatives from operational warfare/platform sponsors, SYSCOMs, Fleet commands, and laboratories. These requirements are documented and disseminated via a Navy Environmental Quality requirements database. The Navy S&T community uses these requirements to define and structure their environmental-related basic, exploratory, and advanced technology demonstration programs. The Navy 6.4 Dem/Val RDT&E program integrates this process with the CNO Program Objective Memorandum (POM) process to generate demonstration/validation planning/execution documents and associated Congressional budget exhibits.

The Navy EQ S&T requirements are established based on high priority needs as expressed by the Fleet, CNO staff and the various Systems Commands. The specific documents that have

been used are the Science & Technology Requirements Guidance from CNO N091, and the Environmental Quality Research, Development, Test and Evaluation (RDT&E) Strategic Plan User Requirements from CNO N45. These requirements were forwarded to ONR from CNO and are received by the individual Program Officers responsible for the various levels of research (6.1 through 6.3). The requirements were reviewed, prioritized, and discussed with the major Navy customers (NAVSEA, NAVFAC, NAVAIR, etc.) in conjunction with the appropriate CNO sponsors.

AIR FORCE

The Air Force uses the Environmental, Safety, and Occupational Health (ESOH) Technical Planning Integrated Product Team (TPIPT) to identify and analyze the Air Force ESOH technology requirements. The ESOH TPIPT is facilitated by the Human Systems Center Directorate of Planning (HSC/XRE).

TPIPT Membership is comprised of key Air Force stakeholders, including:

- AF Civil Engineering
- Logistics and Biomedical Health and Safety from each of the following:
 - AF headquarters
 - Major Command (MAJCOM)
 - Air Logistics Center (ALC).

HSC/XRE conducts the Technology Needs Survey semi-annually by visiting each major installation and MAJCOM across the Air Force to solicit needs from stakeholders. Analysis of the findings are accomplished by the HSC/XRE and forwarded to the ESOH TPIPT for prioritization, final analysis, and validation. Those requirements deemed to require technology development are coordinated with the Air Force R&D community.

SERDP / ESTCP

Both SERDP and ESTCP are Defense-wide programs and, as such, do not establish requirements. Rather, they respond to the high-priority requirements that are stated in the DETRS and broadly addressed in the DTOs. Preference is given to requirements that have multi-service application over those with a single service focus.

D. Program Planning

Upon formalization of the environmental technology requirements, each of the sponsors (the Services, SERDP, and ESTCP), with OSD oversight, develops programs for environmental research and technology development to address those requirements. Again, the processes used by each organization vary in structure, but they are focused on the same goal: addressing the highest priority environmental technology needs. A brief overview of each of the program planning and development processes follows in the sections below.

OFFICE OF THE SECRETARY OF DEFENSE (OSD) – DEFENSE WIDE

The DTO outlined in the DTAP provides broad performance objectives for an environmental technology capability need across all of the Services. The DTOs also identify the expected benefits and anticipated technical challenges in pursuing the technology. Specific milestones and metrics are provided for the current year as well as subsequent fiscal years and form the basis for evaluations during the Technology Area Review and Assessment (TARA) process that has been developed to ensure scientific quality and programmatic progress.

ARMY

To provide guidance and focus to the Army's science community, the Army has defined Science and Technology Objectives (STOs). An STO states a specific, measurable, major technological advancement to be achieved by a specific fiscal year. It must be consistent with the funding available and the Future Year Defense Plan.

The Army uses STOs to support Army applied research and advanced technology development funds. These objectives provide feedback to our scientists and engineers about productivity and customer satisfaction. Materiel and combat developers meet annually to review the objectives, which the Army Science and Technology Working Group then reviews and approves. The Working Group ensures and accounts for the Army Training and Doctrine Command's participation in the planning process and provides guidance to organizations performing science and technology research. All Army Planning, Programming, Budgeting, and Execution System submissions, including budget estimates and execution plans and Defense Technology Objectives (DTOs), should comply with Army STOs guidance.

Among four current Environmental Quality STOs, the Army includes two in restoration and one each in compliance and conservation. The primary goals of the STOs in the Restoration Pillar are to reduce costs and expedite Army cleanup programs while protecting human health and the environment.

The Army conducts research and development in characterization and monitoring, remediation technologies, and the fate and effects of all environmental contaminants in all climates. The Army added an unexploded ordnance STO in Fiscal Year 1999 to the Restoration Pillar. The STO in the Compliance Pillar provides numerous technologies for advanced end-of-the-pipe control and treatment of hazardous, toxic, gaseous, liquid, and solid wastes when pollution prevention is not possible. This STO's target is to develop Army systems, operations, and processes to meet existing and anticipated air, water, land, and noise regulations. Army Compliance research and development focuses on describing pollutant and waste behavior, media-specific control and treatment technologies, and monitoring and assessment tools.

The STO in the Conservation Pillar seeks to provide sustainable support for realistic training and testing through improved understanding of how military operations affect natural and cultural resources. Research focuses on developing cost-effective technologies to mitigate military consequences, rehabilitate resources, comply with environmental regulations, and support sustainable ecosystem management.

To initiate program formulation, each of the technology teams identifies a program need to satisfy each high-priority environmental quality user RDT&E requirement. Projects that offer opportunities to leverage funds (e.g., in SERDP/ESTCP) that may help satisfy an Army user RDT&E requirement are identified. The environmental quality technology teams perform an economic analysis of each of the proposed projects to compute payback period, return on investment, and net present value of the potential cost avoidance. Data is reviewed for consistency and reliability, and where data gaps exist, the technology teams are asked to revalidate their data. Furthermore, projects seeking objectives that are being responded to by other programs are rejected.

In final project selection, three criteria have been identified that represent the most important goals of the environmental technology management process and are used to assess each project's applicability to the Army's EQT program:

- the ratio of cost avoidance to investment;
- pillar priority (which reflects both the environmental and mission urgency of the requirement); and
- programmatic risk (which reflects the risk of success or failure of the requirement based on how the program for each requirement was developed).

The program prioritization is presented to the Environmental Technology Technical Council (ETTC) for approval (a description of the ETTC follows on page 17). The Army's Cost and Economic Analysis Center validates the prioritization process. At this point, both the user and developer have worked together to create the program. They have jointly shepherded the program through a winnowing process that results in technology investments in the areas of most critical need and that promises the greatest return on investment as measured by the three criteria listed above.

NAVY

The Navy structured its RDT&E program so that the SYSCOMs, which annually review and validate specific environmental requirements, are responsible for the program planning, management, execution, and transition of RDT&E projects. The Naval Sea Systems Command, Naval Facilities Engineering Command, Naval Air Systems Command, and Office of Naval Research perform this function for Navy afloat, ashore, aviation, and S&T environmental protection RDT&E programs, respectively.

After specific high priority focus areas are agreed upon, calls for S&T proposals are promulgated via various vehicles (BAAs, Letter Call for Proposals, etc.). Proposals received are then forwarded to evaluation panels consisting of representatives from ONR, the major claimants, CNO and specific area experts. The proposals are evaluated, scored and discussed. The resulting selections are incorporated into the appropriate EQ Investment Plan (e.g., 6.1, 6.2, or 6.3) and submitted to the appropriate Program Manager for execution. Execution of the programs are accomplished by means of formal Program Reviews and informal meetings between Program Manager, PIs and the Integrated Product Team (IPT) established for each major task in the 6.3 program.

Strategic, program, and fiscal planning for the 6.4 Dem/Val program is directed and coordinated through the CNO POM process. The CNO generates an EQ Baseline Assessment Memorandum (BAM) that defines dem/val program priorities, environmental requirements, and fiscal level-of-effort. The SYSCOMs use this EQ BAM to develop program and project plans. Furthermore, the EQ BAM serves as a centrally coordinated transition and implementation mechanism for environmental RDT&E products.

Within each RDT&E project, objectives, tasks, and documentation requirements are identified. The level of detail requirements in these project plans increase from Basic Research through Demonstration/Validation. Basic Research objectives are broad, while Demonstration/Validation projects have specific deliverables. In addition, a yearly task description containing the following items is produced for each project:

- Navy problem/deficiency
- Technical objective
- Expected payoff
- Technical background and approach
- Summary of prior year's effort
- Summary of current year's effort and planned outyear efforts
- Transition plan
- Relationship to other programs.

These plans and their included milestones and metrics are the standards against which progress is measured during in-process, quarterly, semi-annual, and annual reviews.

AIR FORCE

In a process similar to that used by the other military Services, the TPIPT Environmental Technology leader develops a consolidated 6.1 through 6.4 program plan in response to the requirements for R&D as determined by the TPIPT. Program managers work with other AF TPIPTs and interact directly with end users, including MAJCOM representatives, the Pollution Prevention Integrated Process Team (IPT) at Aeronautical Systems Center, the C-17 IPT, the Airborne Laser (ABL) Program Office, individual installations, and each Air Logistics Center to develop these plans.

This program plan describes the projects that will be executed in the annual program plan and includes potential technology transitions and a transition plan. Annually, the program is presented to and reviewed by the Air Force Research Laboratory's (AFRL) Technology Investment Review (TIR). Criteria for approval of individual programs within the Environmental Technology area include soundness of technical objective, technical challenges, approach, program strengths and weaknesses, recent accomplishments, road maps, expected milestones, and exit criteria.

Each project within the program includes a customer-oriented, top-level description, including:

- How a new-start contract fits into the plan's strategy
- Links to the needs emanating from AF Technology Master Plan
- Impact to customer if the project is severely cut or eliminated
- How the project affects or interacts with the five Integrated Applications Areas (Air Vehicles, Agile Combat Support, Space Vehicles, Sustainment, and Weapons)

Technology Transition is a key factor in Air Force Environmental Technology programs. Before a program has reached an advanced stage of development, products and engineering requirements are clearly outlined. Program managers design engineering and technology demonstrations at an end-user location. Exit criteria are well-defined and briefed at the TIR.

SERDP

SERDP responds to Defense-wide requirements developed by the Services and published by the Deputy Under Secretary of Defense for Environmental Security. An annual investment strategy is developed that allocates funding among the four pillars. This investment strategy is scrutinized by several management and oversight committees, including the Scientific Advisory Board and the multi-agency SERDP Council. Using this strategy as guidance, the Technology Thrust Area Working Groups (TTAWG) develop specific statements of needs for research within each pillar. These statements of need are designed to fill gaps in the existing DoD research program to meet the articulated needs.

Of particular importance is that these TTAWGs are multi-agency technical committees that have inherent knowledge of other Department and agency R&D initiatives and programs. Further, the DoD representatives on the TTAWGs are often the same individuals that help to steer the Reliance process for the Services. Therefore, not only are SERDP projects founded without duplication of effort in the other Federal agencies, but they also have complete support, often including leveraged funding, from the Service leads in any particular technology development area.

Using these statements of need as guidance, an annual call for proposals is solicited to industry, academia, and government researchers. Proposals are evaluated by both an independent peer review team (using a process similar to that prescribed by the National Science Foundation), the multi-agency TTAWGs, and the SERDP statute-created Scientific Advisory Board. Proposals are reviewed for relevancy to the statement of need, technical merit, personnel, cost, collaboration, and transition potential.

Each SERDP project selected has an overarching project plan that includes the objective, technical approach and risks, benefits and payoffs, tasks, funding, Go/No-Go decision points, and a description of any formal or informal cooperative development agreements. In addition, an Execution Plan for each year provides more project-specific information, including annual milestones. The milestones, obligations, and expenditures are tracked through the year as measures of the project's progress.

ESTCP

The Deputy Under Secretary of Defense for Environmental Security [DUSD(ES)] approves an investment strategy that is balanced against the stated needs within three of the four pillars. Similar to SERDP, the ESTCP develops annual calls for proposals to a broad community that solicit technology demonstration and validation to meet the stated Defense-wide environmental needs. Projects are evaluated and recommended by multi-Service and multi-agency review committees for DUSD(ES) approval. These review committee members are either on the SERDP TTAWS or they represent Service organizations that are responsible for developing and implementing new processes and technologies in the field.

All projects are required to submit a formal demonstration plan in accordance with ESTCP guidance documents prior to fieldwork. This plan documents the explicit quantitative goals for the technology and defines the metrics for evaluating its performance. The plan also documents the approach for executing the technology demonstration and validating the technology's cost and performance. Pollution prevention projects require a Joint Test Protocol as part of the demonstration plan that ensures acceptance of the product by all three Services when successfully demonstrated. Therefore, ESTCP projects have technology transfer embodied within the project deliverables.

ESTCP demonstrations are conducted under operational field conditions at DoD facilities. These demonstrations are intended to generate supporting cost and performance data for acceptance or validation of the technology. ESTCP demonstration projects are also required to support the future implementation of the tested technology through the development of appropriate guidance, design, and/or protocol documents.

E. Performance Reviews

Defense Environmental Quality Technology Program performance reviews are provided at a variety of levels. Efforts are reviewed at the project level and the program level and are further reviewed from a technical, financial, and response-to-needs perspective.

At the lowest levels, each of the Services, SERDP, and ESTCP perform annual reviews, at a minimum, of each working project against stated goals, objectives, and milestones. The processes used by each organization vary in the details, which are outlined below, but accomplish the same essential task. Performance of the program, as a whole, is reviewed by the JEMP, various coordinating bodies, and the OSD in their oversight and coordination roles. In many programs, external review by industry and academia is both planned and encouraged. These review processes are briefly described below.

OSD – DEFENSE WIDE

The DDR&E, Director of BioSystems, bi-annually reviews DoD's Environmental Technology S&T programs as part of the TARA process. This review is primarily focused on measuring progress against the Defense Technology Objectives published in the Defense Technology Area Plan. The TARA is organized and executed by the tri-service Reliance panels: the JEMP in the

case of Environmental Technology. Reviewers include external technical experts from government, industry, and academia who provide unbiased assessments and recommendations on programs, plans, funding levels, timelines, cooperative ventures, technological challenges, progress, and overall direction.

ARMY

The Army's ETTC is the primary organization responsible for the management and coordination of environmental technology. It is co-chaired by key senior officials of the Assistant Secretary of the Army for Acquisition, Logistics and Technology [ASA(ALT)] and the Assistant Secretary of the Army for Installations and Environment [ASA(I&E)] with members from:

- Assistant Chief of Staff for Installations
- Army Corps of Engineers
- Army Materiel Command
- Center for Health Promotion and Preventative Medicine
- Deputy Chief of Staff for Operations and Plans

The Army provides a number of review levels. Program management and review is the primary responsibility of the commands, but this responsibility has been delegated, in part, to four technology teams (one for each pillar) to address day-to-day issues. Membership on the technology teams consists of at least three primary members, including an S&T representative, a user representative, and a technology transfer/transition representative. These reviews include technical progress against the established objectives and milestones, continued applicability of the developing technology, responsiveness to user needs, and adequacy of resources to achieve the objectives as well as obligation and disbursement progress.

The Army's Environmental Quality Technology Integrated Process Team (ETIPT) conducts periodic program reviews that focus on both recurring and topical issues. Recurring issues include preparation for annual program reviews, such as those conducted by OSD. Topical reviews can focus on high-priority program issues, such as support to formulation of the DoD Range Rule for unexploded ordnance. The ETIPT is responsible for working in close coordination with the commands that have management responsibility for the Army laboratories and centers.

As technologies mature and are ready to be transferred to the field, the ETIPT informs the ETTC on the status of the transfer. A review is conducted by the ETIPT to ensure users have programmed the funds to field and implement the technology as appropriate. An analysis is conducted once the technology has been fielded to compare the projected cost avoidance to the actual costs. The results are used to revise future operating costs.

NAVY

Similar to the Army's process, the Navy has multiple levels of review. Basic Research (6.1), which is longer term and more academically oriented, is reviewed annually for both technical and programmatic execution. Applied Research (6.2) and Advanced Technology Development

(6.3) working projects are reviewed twice a year. These reviews include programmatic execution (obligations and expenditures), technical execution, technical progress, and transition activities. The metrics used include the project's objectives, milestones, and deliverables. Participants in the review include the ONR program managers and area specialists, the Chief of Naval Operations Environmental Coordinator (CNO N45), and the relevant SYSCOM program managers who are the transition agents or end users. These reviews, as well as site visits, provide the basis for decisions with respect to continuing, accelerating, or terminating the project's funding.

For the RDT&E Dem/Val program, the SYSCOMs perform various levels of in-progress reviews for their afloat, ashore, and aviation programs. Monthly project-level reviews by the SYSCOM program manager provide management and technical progress information. Metrics for progress and performance, as determined and documented in an initial project task summary, are continually assessed throughout the fiscal year. The CNO requirements manager assesses SYSCOM-level execution performance and progress annually for each major program area and makes adjustments as necessary.

AIR FORCE

Three major AF reviews are conducted throughout the year:

- (1) Technology Investment Review (TIR). An annual review each April by Air Force Research Laboratory Materials and Manufacturing Directorate (AFRL/ML) Executive Committee of all 6.1, 6.2, and 6.3 programs and projects. The review covers objectives, requirements, users/customers, interactions, future plans, and funding. The AFRL/ML Executive Committee provides feedback, instruction or redirection for each core technology area, one of which is environmental technology. Criteria for evaluation (metrics) of individual programs within the environmental technology area includes soundness of technical objective, technical challenges, approach, program strengths and weaknesses, recent accomplishments, road maps, expected milestones, and exit criteria.
- (2) Air Force Materials and Manufacturing Directorate Roadmap Review. In July there is an annual presentation to industry of AF programs, including Environmental Technology. This allows industry a glimpse of the goals of the AFRL/ML Directorate and invites review of directorate planned programs, past successes, emerging opportunities, and areas of ongoing collaboration with industry. Industry is encouraged to provide feedback on strategies and allows them to plan ahead for upcoming opportunities.
- (3) Technology Area Review (TAR). Each fall, every division conducts an annual internal review, designed to assess the technical merits and/or accomplishments of ongoing or planned programs. Customer focus is highlighted as a key metric.

SERDP / ESTCP

SERDP and ESTCP hold annual In-Progress Reviews (IPRs) jointly. These IPRs are organized by pillar and by technology across both programs. For example, all of the efforts in both programs for developing technologies to detect and characterize UXO are briefed together under the Cleanup pillar. Members of the review committee include the SERDP TTAWG and members from the Services' engineering service centers. Each of the four TTAGWs is composed of members from each of the Services; OSD/Environmental Security; DOE Offices of Environmental Management, Defense Programs, and Science; the EPA; the Coast Guard; the Office of Operational Test & Evaluation; and the DTRA. The engineering service centers (Air Force Center of Environmental Excellence, Army Environmental Center, and Naval Facilities Engineering Services Center) are the organizations that are predominantly responsible for implementing these technologies. As mentioned earlier, TTAWG membership often overlays the JEMP technical leads for each pillar. Therefore, as projects are being reviewed for their technical and financial progress, the JEMP members on the TTAGWs are also assessing how these projects fulfill their own service needs.

At a higher level of review, SERDP projects funded in excess of \$900K per year are reviewed annually by SERDP's Scientific Advisory Board (SAB). The SAB is a statutory Federal Advisory Committee consisting of external experts from academia, industry, environmental groups, and Federal and state governments. Their broad expertise and knowledge of non-Federal research and development often helps focus SERDP efforts on technology gaps not being filled by academia, industry, or other research organizations.

For day to day control, both SERDP and ESTCP require each project to report on a quarterly basis on technical progress as well as monthly obligations and expenditures. Technical progress is measured against the project's stated annual milestones. This provides the program managers the ability to spot problems early and to take action before the annual reviews are conducted. In addition, both SERDP and ESTCP projects require technical reports. SERDP requires an annual and final technical report, and each ESTCP project is required to submit a formal demonstration plan before initiating field work, a final report, and a cost and performance summary report, each of which undergoes external technical review.

F. Projects Directed by Congress

Every year, Congress directs the DoD to pursue technologies to resolve particular problems. Congressional additions, or "adds," address specific projects that are sometimes limited to defined geographical areas and may or may not address high-priority requirements for the DoD or any of its Services. The additional challenges posed by unscheduled and significant funding are substantial. In most cases, the scope of the effort is not known until the Defense Bill has been passed. Consequently, the investment control processes described earlier cannot apply to these special situations, but rather a compressed project formulation process is implemented to ensure insertion of basic project control requirements.

Significant management is required to identify the project's real intent and scope, assess how the effort can be structured to support defense needs (if at all), compete the work, if appropriate, and

prepare work plans that can satisfactorily produce and measure usable products. While Congressional adds result in a doubling or tripling of an organization's appropriation, there is a significant increase in staff time and effort required to manage the overall program.

III. Trends

A. Environmental Technology Funding

Stable funding is essential for a sustained, efficient, and successful R&D program. This stability ensures that the research infrastructure is firmly in place to continue to grow the seeds that have been planted in the previous year(s). Consequently, major funding deviations, either in the form of a budget cut or increase, have a detrimental effect on R&D. In a budget decrease, this infrastructure is naturally fragmented to seek other work. Oftentimes the workforce finds that unstable and unpredictable funding trends have too great an impact on their livelihood, compelling them to seek more stability elsewhere. Conversely, in an uptrend, R&D management has little time to efficiently plan for the work ahead and has difficulty in immediately finding qualified teams to perform the work. Much of this additional work is offered to the private sector.

As shown in Figure III-1, over the past four years funding for Defense Environmental Technology Programs ranged from a high of \$276 million in FY 1995 to a low point of \$207 million in FY 1998. FY 1999 reflected an increase to near FY 1995 levels in appropriation for Environmental Technology programs, but this figure is somewhat misleading since the increase was primarily a result of congressional additions.

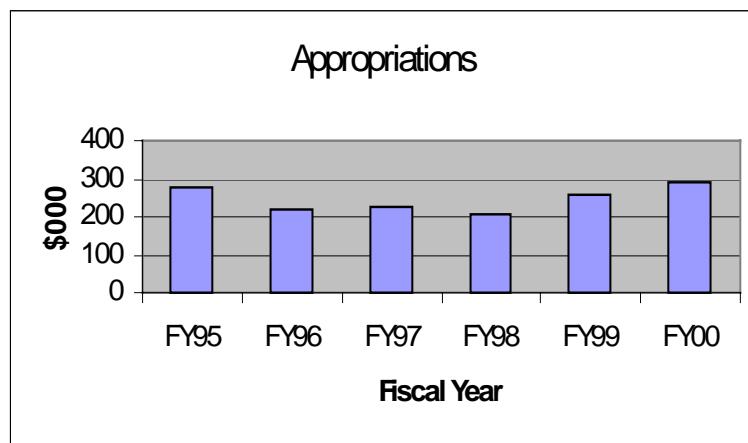


Figure III-1

Figure III-2 represents the difference between the President's Budget Request for DoD Environmental Technology and the resultant appropriations for the past four years as well as for FY 2000. The steady increase in variance is primarily the result of congressional additions. Specifically, in FY 1999, DoD's Environmental Technology Appropriation was approximately 30 percent higher than the budget requested; a significant part of which was as a result of congressional adds to the Army and Navy programs. This unexpected increase requires a significant and commensurate effort in management resources.

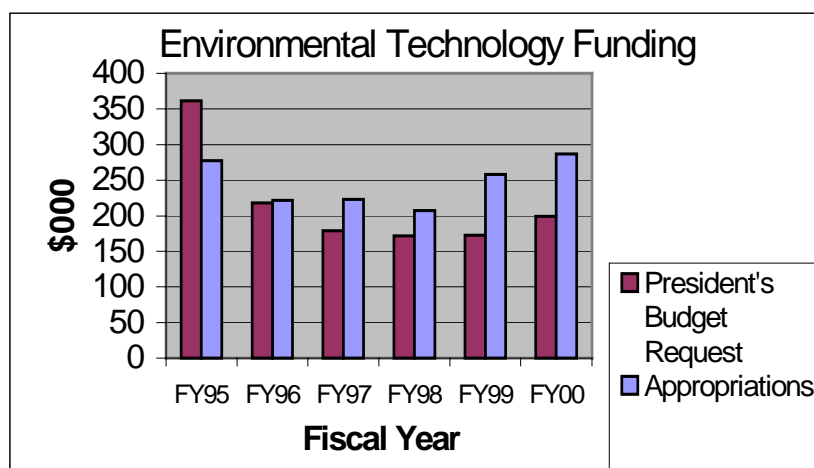


Figure III-2

In reaction to reductions in the President's Budget Request for Environmental Technology that occurred during the first half of the 1990s, DoD reemphasized cooperatively and jointly funded programs where applicable. This has been especially appropriate in technology areas that cross the boundaries between Services. While this strategy takes advantage of the limited resources available, it also increases the amount of management effort needed to effectively coordinate needs, tasks, schedules, and deliverables.

B. Distribution Among Pillars

Funding trends among the four pillars indicate a clear and deliberate shift from a cleanup posture to one of pollution prevention. Although investments in cleanup technology development continue to yield high returns on investment, the Department's plan to allocate a greater percentage of anticipated future funds to pollution prevention technologies validates the DoD's commitment to meeting its environmental responsibilities. However, two difficult cleanup problems experienced by DoD, UXO and chlorinated solvents, demand a substantial and steady stream of resources to overcome their detrimental effects on society. Accordingly, the DoD will maintain a strong technology development program in cleanup, while decreasing slightly over time the percentage of available funds invested in cleanup technology development.

The Department of Defense seeks to assume a prevention-based philosophy: one that is forward-looking by eliminating pollution at the source, rather than retrospective by controlling,

treating, or cleaning up current and past contaminants. Since 1990, Environmental Technology programs have contributed to DoD's achieving its goal of a 50-percent reduction in Toxic Release Inventory (TRI) releases, as directed by Executive Order 12856. In the future, emphasis will be placed on pollution prevention approaches to maintain compliance. An immediate shift in resources to P2 is anticipated. Inherent in this DoD philosophy is a promotion of sustainable development. An example of recent initiatives may be found in the Green Munitions projects, including:

- Green Missile that seeks to replace hazardous missile components
- Green Bullet that replaces lead and other toxic or hazardous components with non-toxic materials
- Green Energetics that formulates fourth generation explosives with minimal waste streams by using advanced computational methods
- Laser Ignition to replace lead primers in medium-caliber weapons.

Compliance with current environmental regulations is the near-term goal of the DoD. New regulations that impact air emissions, testing and training range operations, and other emissions control issues may have a deleterious effect on the readiness of our Armed Forces. The Environmental Technology programs will continue to research methods to reduce negative environmental impacts on DoD activities. Specific initiatives include:

- NOx and particulate emissions
- Range scrap and residue
- Ship effluents
- Packaging residue

Recent trends in environmental regulations include the following: standards are tightening, increased authority has been assumed by the states, and regulators are focusing on regional issues rather than individual activities. Resource allocation will occur commensurate with changes in the regulations.

As land that is reserved for training and testing purposes becomes more and more restricted, it is incumbent upon DoD to become responsible stewards of the land that is managed. Facility managers are seeking effective tools with which they can efficiently control and sustain training and testing lands and their associated natural and cultural resources. Research results from this area will assist in resolving legal impediments that may have occurred due to a lack of scientific basis. Cooperative funding in this area with other Federal activities is essential to efficiently achieve a wide variety of conservation objectives, including:

- Management of cultural and natural resources
- Management of threatened and endangered species
- Maintenance and restoration of severely impacted training/testing lands

Funding for conservation initiatives is expected to increase, especially as technologies mature to demonstration phase.

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IV. Summary

The Defense Environmental Technology programs are vital to maintaining adequate readiness of our Armed Forces and essential to ensuring DoD compliance with current and anticipated regulations. These programs respond to the highest priority needs, are well planned and fully coordinated, and are capable of withstanding scrutiny by both internal and independent review teams.

The DoD Environmental Technology Program's investment control process mirrors the DoD's process for all research and development. Similarly, each Service and program sponsor effectively follows the planning, programming, and budgeting system cycle, and has its own version of the following: defense requirements identification and prioritization, objectives development, program build systems, and evaluation of performance. Although not identical, each process embodies the essential elements of a quality investment control process that is expected of all defense R&D programs.

All sponsors of Environmental Technology programs seek the collaboration of other Federal departments and agencies, as well as partnerships with the commercial sector. These collaborations allow DoD to leverage limited resources for mutual benefit, to focus on the highest defense environmental needs, and to efficiently transfer and implement new technologies into field use.

Finally, DoD seeks stable funding to maintain a consistent effort to achieve its technical goals and objectives. After investing over two years of effort for each execution year, any significant variance from the President's Budget Requests often can impact the quality of program planning, execution, and evaluation. The Department is encouraged by Congressional support of its programs and will continue to efficiently execute the resources provided.